

HYDROLOGY/DRAINAGE STUDY  
FOR TENTATIVE PARCEL MAP 20976 RPL

405 RANGER ROAD  
FALLBROOK, CA

APN 108-081-06

**PREPARED BY:**

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Prepared for:

County of San Diego

Date:

December 5, 2006  
Revised April 5, 2007  
Revised Nov. 27, 2007

PROJECT DISCUSSION:

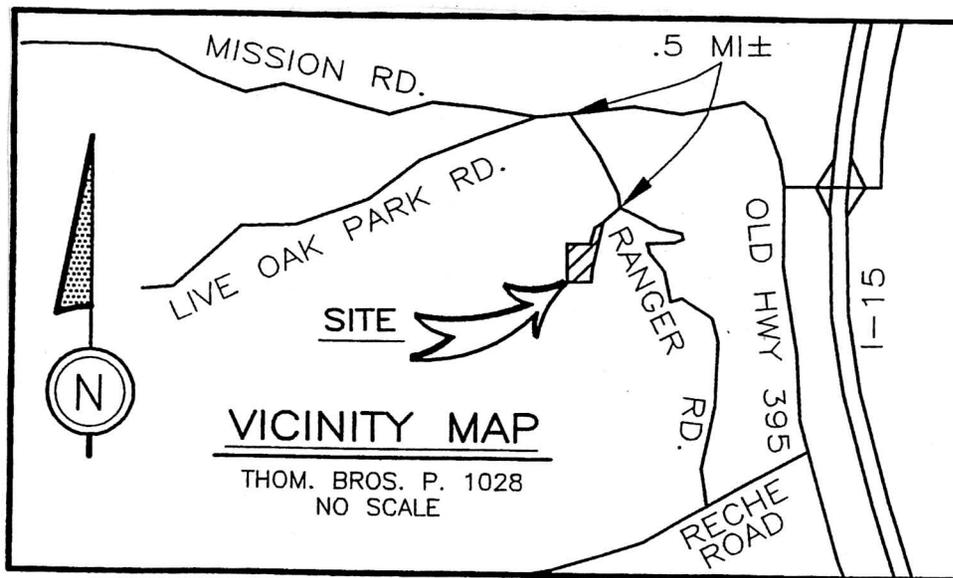
The scoping letter dated December 6, 2005 for TPM 20976 required a hydrology drainage study.

This study has been prepared to determine the project impact on the quantity and pattern of runoff to the surrounding area. The report addresses siltation and erosion associated with the runoff. The report also describes the drainage amounts falling on the site and shows how the drainage is directed on individual parcels and onsite roads.

This report will describe drainage structures and locate them on the project map.

The proposed development will not disrupt drainage or cause off-site flooding. The report will discuss potential impacts and proposed mitigation measures.

PROJECT VICINITY MAP:



Three watersheds affect the property. The larger watershed, Area "A", divides the property in a north-south direction and ends near the south property line in a one acre +/- area pond. This watershed is approximately 70 acres with an elevation difference of 300 ft. and a watershed length of 3300 ft. approximately 9 acres of this watershed is onsite. The area of inundation for this drainage area is shown on the tentative map.

The easterly watershed, Area "B", is along the easterly property line and the watershed is approximately 24 acres, with an elevation difference of 190 feet and a watershed length of 2000 feet. Approximately 6 acres of this watershed is onsite. The upper area of this watershed 6 acres flows under the access road in an existing culvert.

The westerly watershed, Area "C" is westerly of the property and the watershed also ends near the south property line in the one acre +/- pond. This watershed is approximately 16 acres with an elevation difference of 220 ft. and a watershed length of 1500 ft. approximately 3 acres of this watershed is onsite.

The rational method was used to analyze the 100 year flow event for these watershed areas. The project is adding 0.5 acres of paved roadway (0.8 ac existing) and 0.7 acres of paved driveways. Four additional residences are proposed with a roof area of 0.3 acs. for a total of newly paved areas and roof area of 1.5 acres.

Utilizing the rational method the existing proposed flow volumes are tabulated in the following Summary Table. The project impact on the quantity and pattern of runoff to the surrounding area will not be impacted from this project. For the new development areas, the onsite bio filters will mitigate increase flows from roadways and pads.

The onsite pond with a surface of 0.5 acs, although not a part of the proposed BMP, will prevent during construction, any onsite erosion from impacting areas offsite.

**SUMMARY TABLE**  
Design Storm = 100 year

UNITS	AREA A		AREA B		AREA C		AREA D	
	EXISTING	PROPOSED	EXISTING	PROPOSED	EXISTING	PROPOSED	EXISTING	PROPOSED
L	3300	300	2000	2000	1500	1500	4000	4000
ΔE	300	300	190	190	220	220	330	330
S								
TC	16.8	16.8	13.5	13.5	11.4	11.4	19	19.0
C	0.365	0.374	0.34	0.35	0.365	0.375	0.36	0.367
I <sub>100</sub>	4.2	4.2	5	5	5.5	5.5	4	4
A	70	70	24	24	16	16	110	110
Q <sub>100</sub> cfs	107.3	109.4	42.0	42.0	32.1	33.0	158.0	161.0
Q <sub>85</sub> cfs	28.1	28.5	10.5	10.5	8.2	8.4	39.6	40.4



## SUMMARY & CONCLUSION:

- a. The proposed project would not substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site. Bio filter are proposed at all outlets from existing and proposed roads, driveways and pad areas which will prevent substantial erosion or siltation on and offsite.
- b. The proposed project would not substantially alter the existing drainage pattern of the site or area not including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on or offsite. Increased flows are minor less than 2% and this increase will be mitigated by the proposed bio filters on site.
- c. The proposed project would not increase or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems The proposed increase less than 2% will be mitigated by the propose bio filters on site.
- d. The proposed project would not place housing within a 100 year flood hazard area as mapped on a Federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map, including County Floodplain Maps. The drainage areas within and through this property are small (70 ac, 24 ac & 16 ac) compared to the areas that are mapped on Federal Flood Hazard Boundary or Flood Insurance Rate Map, County Flood plain maps or other flood hazard delineation maps. This project would not place housing within a 100 year flood hazard area as all proposed sites are well above any drainage areas.

AREA "A"

SOIL GROUP  $\frac{1}{2}$  B +  $\frac{1}{2}$  D

$$C_{AVG} = \frac{0.32 + 0.41}{2}$$

$$C_{AVG} = 0.365$$

PRE CONSTRUCTION

$$Q_{85} = 0.365(1.1)(70)$$

$$Q_{85} = 28.1 \text{ cfs}$$

$$Q_{100} = 0.365(4.2)(70)$$

$$Q_{100} = 107.3 \text{ cfs}$$

USE 42" CULVERT @ CUL-DE-SAC

$$\underline{HW} = 2.2 \text{ CAPACITY} = 110 \text{ cfs}$$

D

EXCEEDS 109.4 CFS

∴ OK

AREA "B"

SOIL GROUP  $\frac{1}{2}$  B +  $\frac{1}{4}$  C +  $\frac{1}{4}$  D

$$C = 0.34$$

PRE CONSTRUCTION

$$Q_{85} = 0.34(1.25)(24)$$

$$Q_{85} = 10.2 \text{ cfs}$$

$$Q_{100} = 0.34(5.0)(24)$$

$$Q_{100} = 40.8 \text{ cfs}$$

ACREAGE 70 ACS.

WATERSHED L = 3300 FT.

WATERSHED H = 300 FT.

SLOPE WATERSHED S = 9%

SLOPE WATERSHED S = 9%

$$T_c = 10 + 6.8$$

$$T_c = 16.8$$

$$I_{85\%} = 1.1 \text{ INS/HR}$$

$$I_{100} = 4.2 \text{ INS/HR}$$

POST CONSTRUCTION

ADDITIONAL PAVED AREA

1 ACRE

$$C_R = \frac{0.365(69) + 1(0.8)}{70}$$

$$C_R = 0.371$$

$$Q_{85} = 0.371(1.1)(70)$$

$$Q_{85} = 28.5 \text{ cfs}$$

$$Q_{100} = 109.4 \text{ cfs}$$

ACREAGE 24 ACS.

WATERSHED L = 2000 FT.

WATERSHED H = 190 FT.

SLOPE WATERSHED S = 9.5%

$$T_c = 7 + 6.5 = 13.5 \text{ MINS.}$$

$$I_{85\%} = 1.25 \text{ INS/HR}$$

$$I_{100} = 5.0 \text{ INS/HR}$$

ADDITIONAL PAVED AREA=0.5 AC

POST CONSTRUCTION

$$C_R = \frac{0.34(23.5) + 0.8(0.5)}{24}$$

$$C_R = 0.35$$

$$Q_{85} = 0.35(1.25)(24)$$

$$Q_{85} = 10.5 \text{ cfs}$$

$$Q_{100} = 35(5.0)(24)$$

$$Q_{100} = 42 \text{ cfs}$$

**AREA "C"**

SOIL GROUP 1/2 B + 1/2 C

C = 0.365

Q<sub>85</sub> = 0.365(1.4)(16)  
Q<sub>85</sub> = 8.2 cfs

Q<sub>100</sub> = 0.365(5.5)(16)  
Q<sub>100</sub> = 32.1 cfs

ACREAGE 16 ACS.  
WATERSHED L = 1500 FT.  
WATERSHED H = 220 FT.  
SLOPE WATERSHED S = 14.7%

T<sub>c</sub> = 5 + 6.4 = 11.4 MINS.  
I<sub>85%</sub> = 1.4 INS/HR  
I<sub>100</sub> = 5.5 INS/HR  
ADDITIONAL PAVED AREA = 0.4 AC  
C = 0.8

C<sub>R</sub> =  $\frac{0.365(15.6) + 0.8(0.4)}{16}$

C<sub>R</sub> = 0.375  
Q<sub>85</sub> = 0.375(1.4)(16)  
Q<sub>85</sub> = 8.4 cfs  
Q<sub>100</sub> = 0.375(5.5)(16)  
Q<sub>100</sub> = 33 cfs

PROPOSED CULVERT @ DRIVEWAY PARCEL NO. 4  
USE 30"  $\frac{HW}{D}$  = 1.5 CAPACITY = 35 cfs

EXCEEDS 33 cfs ∴ OK

**TOTAL FLOW @ SOUTH PROPERTY LINE**

**PRE CONSTRUCTION**

AREA = TOTAL  
C<sub>avg</sub> = 0.36

Q<sub>85</sub> = 0.36(1.0)(110)  
Q<sub>85</sub> = 39.6 cfs  
Q<sub>100</sub> = 0.36(4.0)(110)  
Q<sub>100</sub> = 158 cfs

ACREAGE 110 ACS.  
WATERSHED L = 4000 FT.  
WATERSHED H = 330 FT.  
SLOPE WATERSHED S = 8.25%  
T<sub>c</sub> = 12 + 7 = 19 MINS.  
I<sub>85</sub> = 1.0  
I<sub>100</sub> = 4.0

**POST CONSTRUCTION**

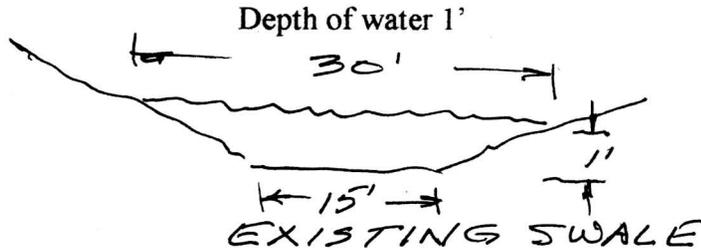
C<sub>R</sub> = 0.367  
Q<sub>85</sub> = (0.367)(4.0)(110)  
Q<sub>85</sub> = 40.4  
Q<sub>100</sub> = 0.367(4.0)(110)  
Q<sub>100</sub> = 161 cfs

AREAS OF INUNDATION  
NORTH PROPERTY LINE TO POND

AREA = 70 ACS.

$Q_{100} = 109.4$  cfs

Average slope channel = 4%  
Assume channel width 30 ft.



Water level 1 ft.

$a = 22.5$  sq. ft.  
 $W_p = 30$  ft.

Use formula

$$r = \frac{22.5}{30} = 0.75$$

$$Q = \frac{1.486}{n} a r^{2/3} S^{1/2}$$

$$r = 2/3 = 0.82$$

Assume  $n = 0.04$

$$S^{1/2} = 0.2$$

$$r^{2/3} = 0.82$$

$$a = 22.5$$

$$Q = \frac{1.486 (22.5)(0.82)(0.2)}{0.04}$$

$$Q = 137 \text{ cfs } V = 6 \text{ ft/sec.}$$

Exceeds 109.4 cfs  $\therefore$  OK

Channel width 30 ft.

POND TO SOUTH PROPERTY LINE

$$\text{Area} = 70 + 16 + 24 = 110 \text{ acs.}$$

$$Cr = \text{AVG} = \frac{70 \text{ AC } (0.371) + 24 (0.35) + 16 (0.375)}{110}$$

$$Cr = 0.367$$

USE  $I = 4.0$  INS/HR FROM AREA "A"

$$Q_t = CIA = 0.367(4.0)(110)$$

$$Q_t = 161 \text{ CFS}$$

EXISTING CHANNEL

$$S = 5\% \quad S^{1/2} = .224$$



ASSUME

$$n = 0.004$$

$$a = \frac{1}{2} bh$$

$$a = 20 \text{ sq. ft.}$$

$$r = 20/20 = 1$$

$$Q = \frac{1.486}{0.04} (20)(1.0)(0.224)$$

$$Q = 165 \text{ cfs} \quad V = 8.3 \text{ FT/SEC} \quad r^{2/3} = 1$$

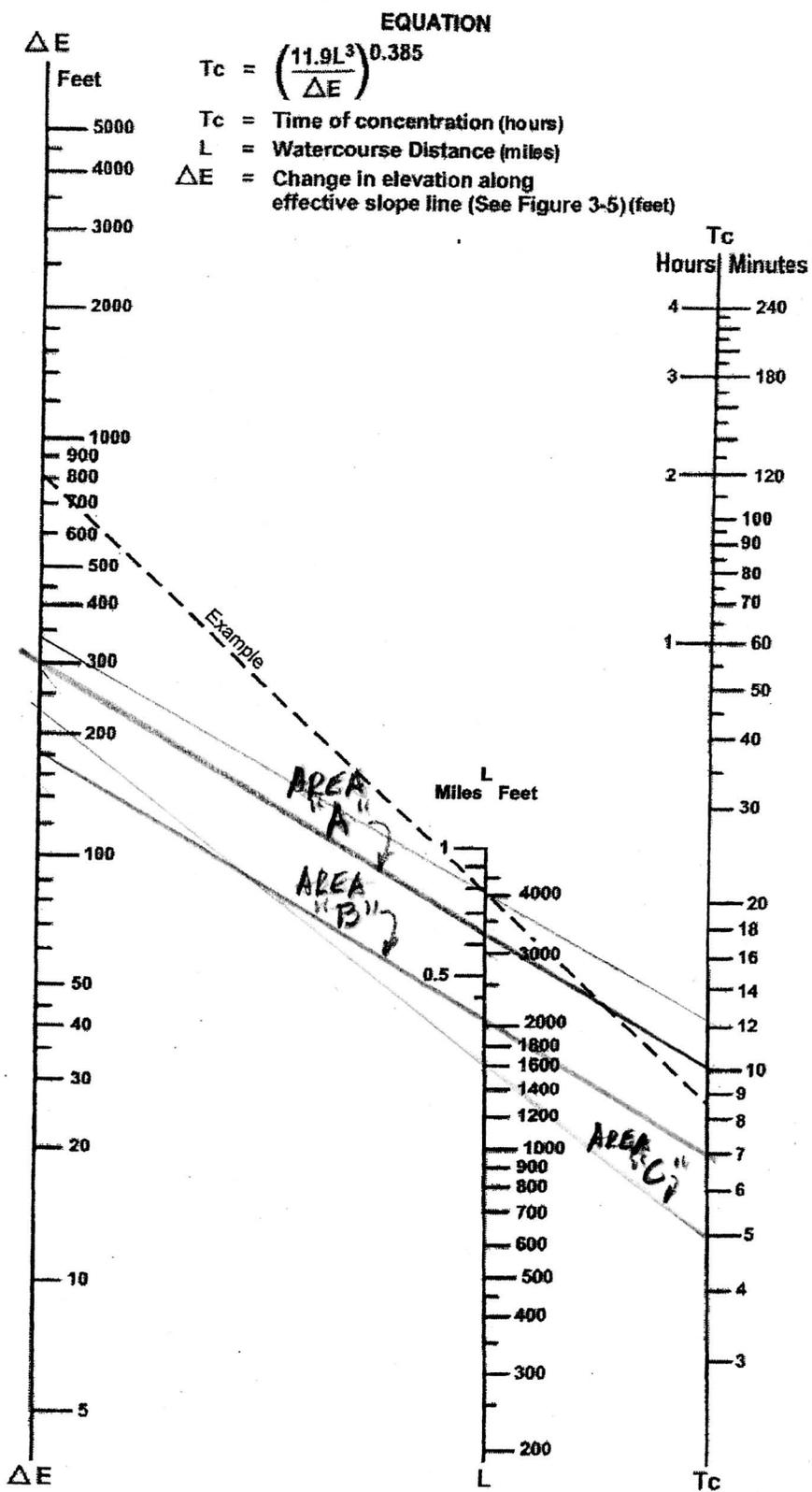
Exceeds 161 cfs  $\therefore$  OK

CHANNEL WIDTH 20 FT.

TABLE OF INCREASED FLOW

	<b>AREA "A"</b>	<b>AREA "B"</b>	<b>AREA "C"</b>	<b>AREA TOTAL</b>
85%	0.4 cfs	0.3 cfs	0.2 cfs	0.8 cfs
% INCREASE	1.4%	2.9%	2.4%	2%
Q100	1.8 cfs	1.2 cfs	0.9 cfs	3.0 cfs
% INCREASE	1.7%	2.9%	2.8%	1.9%

INCREASE FLOWS ARE MINOR AND WILL BE MITIGATED BY THE PROPOSED BIO FILTERS TO A LEVEL LESS THAN SIGNIFICANT.



SOURCE: California Division of Highways (1941) and Kirpich (1940)

Nomograph for Determination of  
Time of Concentration ( $T_c$ ) or Travel Time ( $T_f$ ) for Natural Watersheds

**FIGURE**  
**3-4**

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

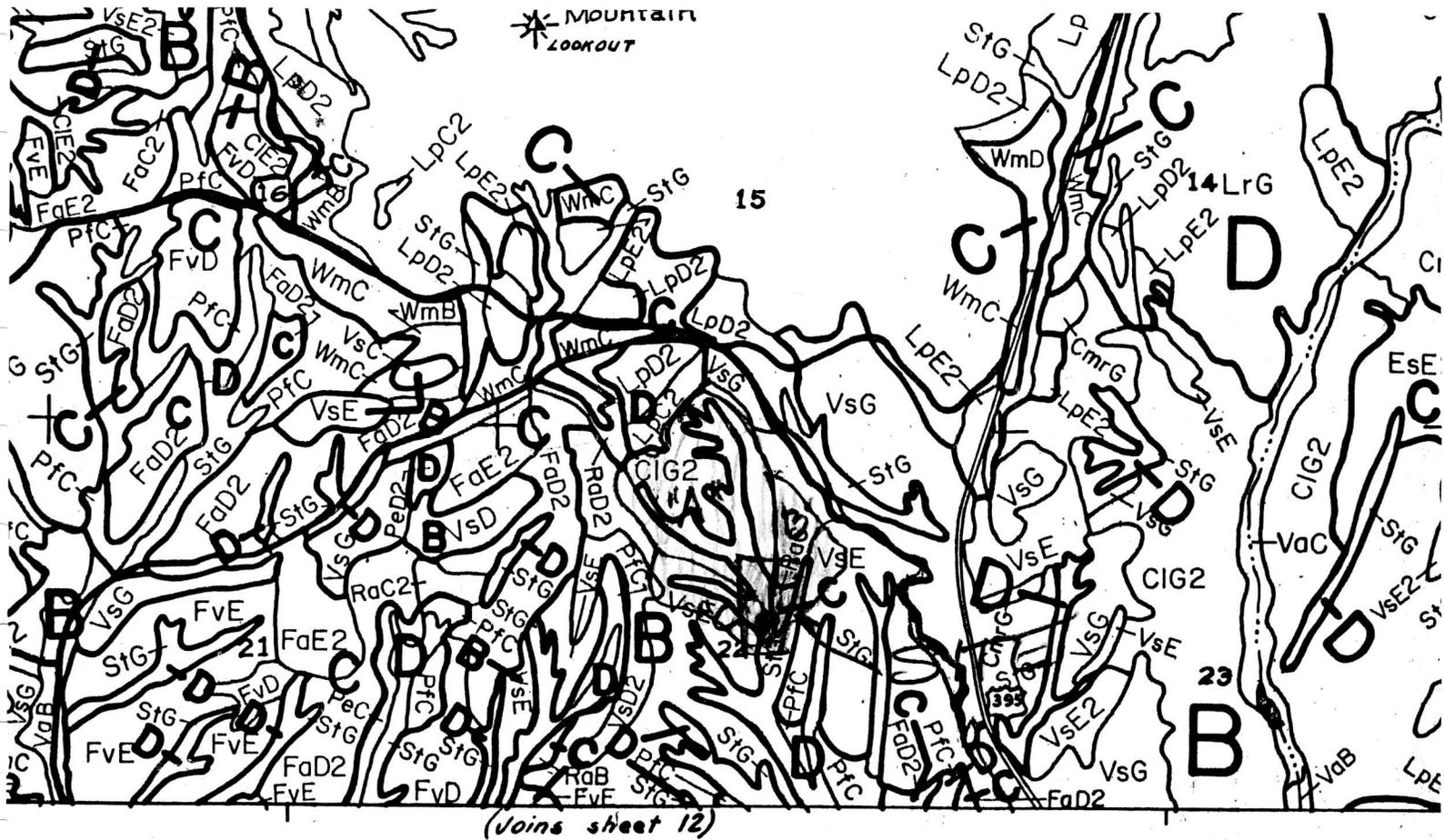
Table 3-2 provides limits of the length (Maximum Length ( $L_M$ )) of sheet flow to be used in hydrology studies. Initial  $T_i$  values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

**Table 3-2**

**MAXIMUM OVERLAND FLOW LENGTH ( $L_M$ )  
& INITIAL TIME OF CONCENTRATION ( $T_i$ )**

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		$L_M$	$T_i$										
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

\*See Table 3-1 for more detailed description

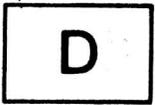


# n Study

## Potential

SEE CAUTION NOTES

Group C  
High Runoff Potential

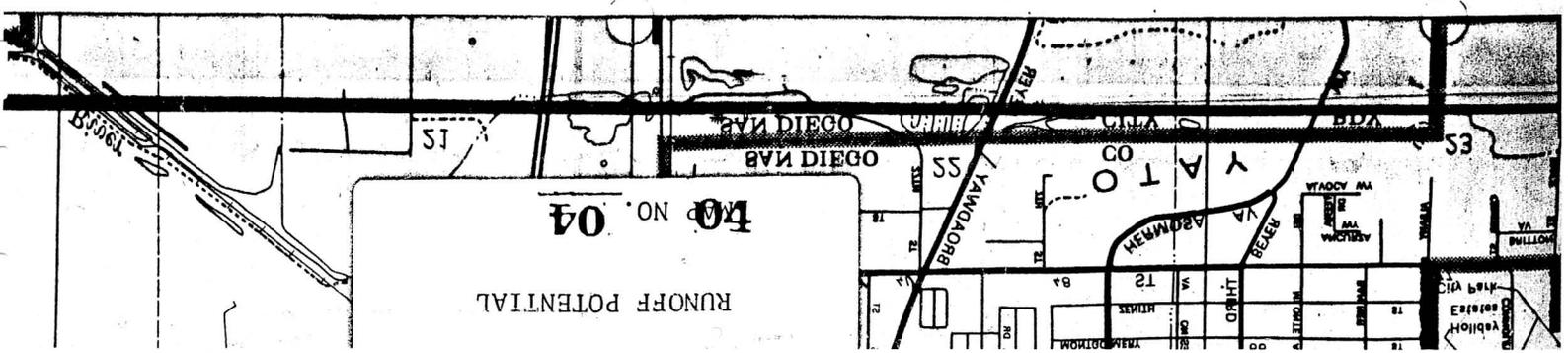


Group D  
Very High Runoff Potential

**CAUTION NOTES:**

1. User is urged to refer to corresponding SUPPLEMENTAL DATA SHEET for assumptions, criteria, map sources, additional legend items, and necessary explanation of ratings shown on map.
2. This map does not eliminate the need for a detailed on-site investigation of the soil and site conditions to determine precise soil conditions prior to taking any construction, grading, planting, or other soils related activity.

Base Map Source: U. S. Geological Survey with California State Coordinate System, Zone 6 Indicated  
 Prepared by: U. S. Department of Agriculture, Soil Conservation Service  
 Published by: San Diego County Planning Department for the Comprehensive Planning Organization



**Table 3-1  
 RUNOFF COEFFICIENTS FOR URBAN AREAS**

Land Use	County Elements	Runoff Coefficient "C"				
		% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

\*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).

DU/A = dwelling units per acre

NRCS = National Resources Conservation Service

# County of San Diego Hydrology Manual



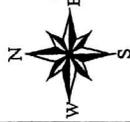
## Rainfall Isopleths

100 Year Rainfall Event - 24 Hours

..... Isopleth (Inches)



We Hired San Diego Covered!  
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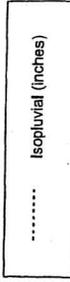


# County of San Diego Hydrology Manual



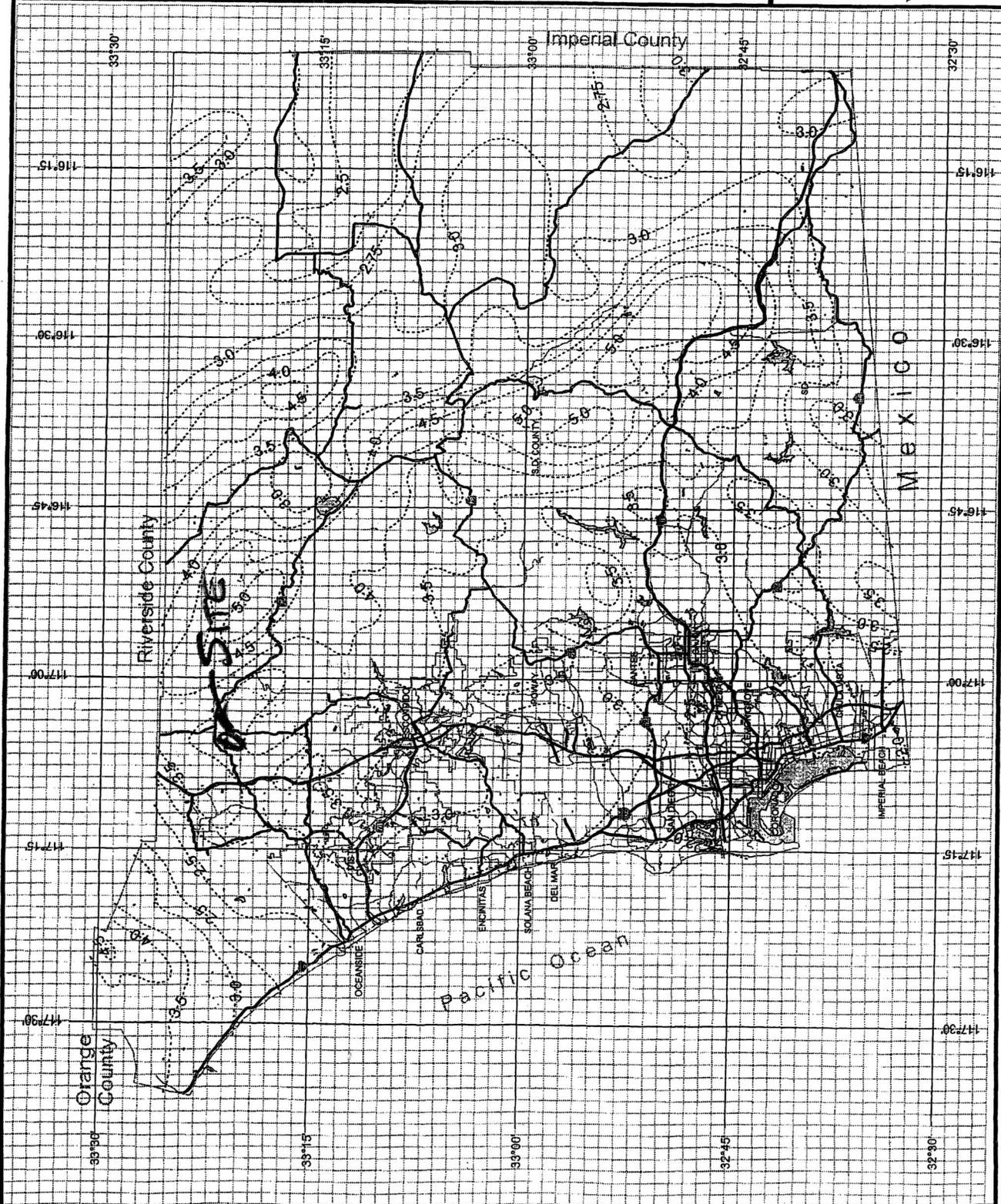
## Rainfall Isoplethals

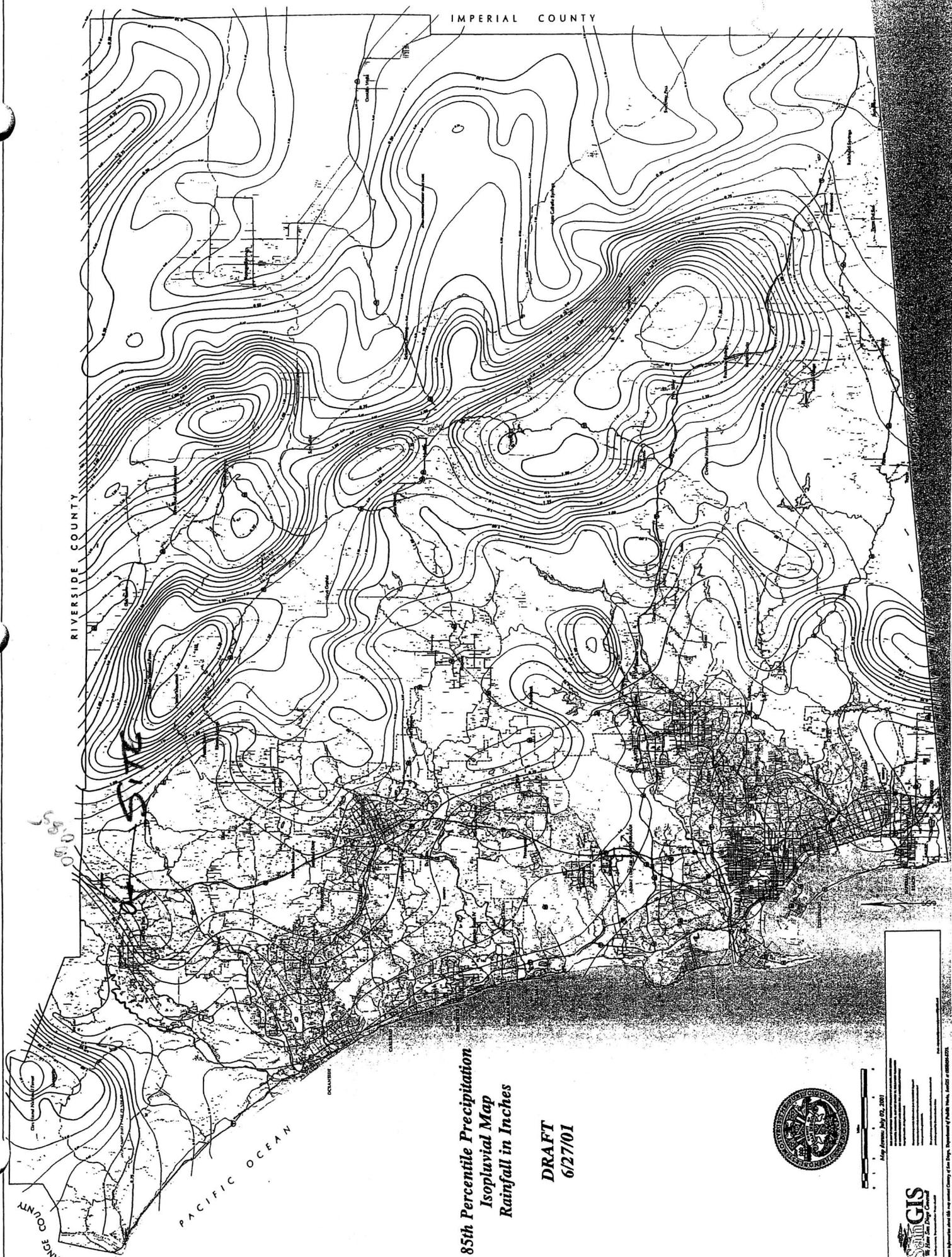
### 100 Year Rainfall Event - 6 Hours



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**85th Percentile Precipitation  
Isoplethial Map  
Rainfall in Inches**

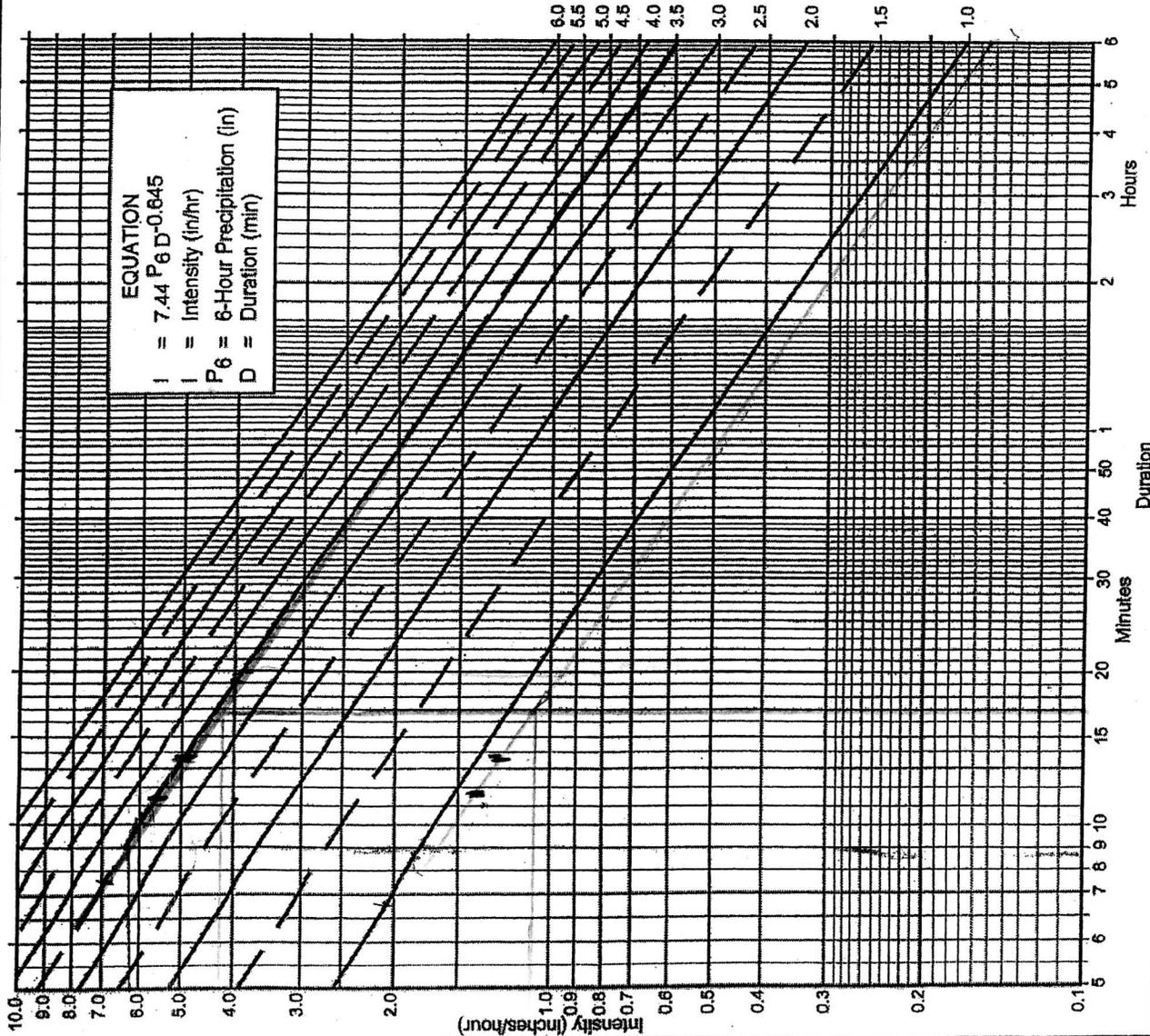
**DRAFT  
6/27/01**



Map Frame - July 02, 2001



For more information about GIS, go to [www.ca.gov](http://www.ca.gov), Department of Public Works, Office of the State Engineer.



**Directions for Application:**

- (1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).
- (2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicable to Desert).
- (3) Plot 6 hr precipitation on the right side of the chart.
- (4) Draw a line through the point parallel to the plotted lines.
- (5) This line is the intensity-duration curve for the location being analyzed.

**Application Form:**

- (a) Selected frequency 100 year
- (b)  $P_6 = 3.5$  in.,  $P_{24} = 6.0$ ,  $\frac{P_6}{P_{24}} = 58\%$
- (c) Adjusted  $P_6^{(2)} = 3.5$  in.
- (d)  $t_x = 16.2$  min.
- (e)  $I = 4.2$  in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

$P_6$	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	1	1	1	1	1	1	1	1	1	1	1
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.88	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.68	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.68	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.78	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.36	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

FIGURE

3-1

Intensity-Duration Design Chart - Template